Inventor: Sudo Hiroaki Matsushita Electric Ind Co Ltd

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2.**** shows the word which can not be translated.
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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the communication device of the OFDM method using especially an interleave technique about the communication device of the OFDM (Orthogonal Frequency Division Multiplexing) method which performs resending control.
[0002]
[Description of the Prior Art] The resending control by the conventional OFDM communication device using an interleave technique is explained with reference to drawing 2 . Drawing 2 is the block diagram showing the configuration of the conventional OFDM communication device using an interleave technique. Hereafter, resending control of the conventional OFDM communication device using an interleave technique is explained taking the case of the case where the 1st communication device and the 2nd communication device equipped with both the OFDM communication devices shown in drawing 2 perform radio. In addition, the 1st communication device transmits a signal to the 2nd communication device, and here explains the case where the 1st communication device transmits this mistaken signal again to the 2nd communication device (resending), when an error exists in the signal which the 2nd communication device received.
[0003] First, a sending signal is stored in the resending control section 11 in the transmitting system of the 1st communication device. This sending signal is a signal of a packet unit. The stored sending signal is transmitted to the interleave processing section 12 by the resending control section 11 according to transmit timing.
[0004] In the interleave processing section 12, the sequence of the signal transmitted from the resending control section 11 is rearranged according to a specific regulation. Predetermined transmitting OFDM processing is made by the transmitting OFDM section 13, and the signal with which sequence was rearranged is arranged at each subcarrier.
[0005] As a result of carrying out interleave processing in the interleave processing section 12, the signal with which the above-mentioned predetermined transmitting OFDM processing was made here keeps predetermined subcarrier spacing, and it serves as a signal arranged at each subcarrier. That is, respectively like [the 1st - the 3rd signal in the sending signal inputted into the interleave processing section 12] a subcarrier 1, a subcarrier 5, and a subcarrier 9, 4 subcarrier spacing is kept and the signal with which the above-mentioned predetermined transmitting OFDM processing was made is arranged.
[0006] The signal with which transmitting OFDM processing was made is transmitted to

the 2nd communication device through an antenna 14. The signal transmitted from the 1st communication device is received by the 2nd communication device through a transmission line.

[0007] As for the signal received from the antenna 14, predetermined receiving OFDM processing is made by the receiving OFDM section 15 in the 2nd communication device. As for the signal with which the above-mentioned predetermined receiving OFDM processing was made, day interleave processing is made by the day interleave processing section 16. As for the signal with which day interleave processing was made, error correction processing is made by the error correction section 17. The signal by which the error correction was carried out is outputted to the resending control section 11.

[0008] In the resending control section 11, when an error does not exist in the signal by which the error correction was carried out, this signal is outputted as an input signal. On the contrary, this signal is stored in predetermined memory when an error exists in the signal by which the error correction was carried out. Then, after the signal containing the packet of the purport which requires resending of this signal is processed by the interleave processing section 12 and the transmitting OFDM section 13, it is transmitted to the 1st communication device through an antenna 14.

[0009] Then, in the 1st communication device, the packet demanded in resending by the 2nd communication device is transmitted to the interleave processing section 12 by the resending control section 11 according to resending timing. The same processing as what was mentioned above is made, and this packet is resent to the 2nd communication device through an antenna 14.

[0010] The signal with which the error existed [in / as mentioned above / the 2nd communication device] is resent by the 1st communication device.

[0011]

[Problem(s) to be Solved by the Invention] However, there is a problem which is described below in the conventional OFDM communication device using an interleave technique. That is, the situation that what the signal of inferior quality concentrated on a certain specific time amount is inputted as a signal which performs error correction processing in the 2nd communication device may occur.

[0012] Here, drawing 3 is referred to in order to explain this situation concretely. Drawing 3 is the mimetic diagram showing an example of arrangement of the subcarrier in the signal received by the conventional OFDM equipment using an interleave technique. In addition, in the interleave processing section 12 in the 1st communication device, interleave processing as shown in the above-mentioned example shall be made.

[0013] When the signal with which the subcarrier as shown in drawing 3 has been arranged is received by the 2nd communication device, like a subcarrier 1, a subcarrier 5, a subcarrier 9, a subcarrier 13, and --, the signal outputted by the day interleave processing section 16 sets 4 subcarrier spacing, and it serves as a signal serially taken out from each subcarrier. Here, a subcarrier 1, a subcarrier 5, a subcarrier 9, a subcarrier 13, and the signal arranged at -- become what has bad quality so that clearly from drawing 3 .

[0014] Consequently, since the signal inputted into the error correction section 17 becomes what the signal of inferior quality concentrated on a certain specific time amount, the effectiveness of the error correction by the error correction section 17 decreases, and the signal with which an error exists is outputted to the resending control section 11 more often. By this, the 1st communication device will resend the same

packet.
[0015] Furthermore, it becomes what is in almost same circuit condition when late and the same above-mentioned packet is first transmitted to the time interval to which fluctuation of a circuit (transmission line) condition transmits the same packet by the 1st communication device as shown in drawing 4 and circuit condition when the same above-mentioned packet is transmitted again (resending).
[0016] In this case, when the signal with which the resent packet was contained is received by the 2nd communication device, the arrangement condition of the subcarrier in this received signal is in the almost same condition as what was shown in drawing 3 . Therefore, in the 2nd communication device, possibility that an error will arise also about the packet resent by the 1st communication device becomes very high, and it becomes the situation which the above-mentioned packet mistakes continuously further. Therefore, by the time the 2nd communication device receives a certain specific packet which the 1st communication device transmitted in the condition without an error, long time amount will be taken.
[0017] This invention is made in view of this point, and aims at offering the OFDM communication device which can reduce the probability which the same packet mistakes continuously.
[0018]
[Means for Solving the Problem] The OFDM sending set of this invention is characterized by to provide two or more interleave means to by_which interleave processing which is mutually different to a sending signal can be performed, a selection means choose an interleave means to by_which interleave processing should be performed to said sending signal, from two or more of said interleave means according to the number of resendings of said sending signal, and an OFDM means perform OFDM processing to the sending signal by which interleave processing was carried out with the selected interleave means.
[0019] Since interleave processing according to the number of resendings of a sending signal is performed to the above-mentioned sending signal among two or more interleave processings of being mutually different according to this invention, the probability which the same sending signal mistakes continuously can be reduced. Thereby, when a certain specific sending signal is mistaken, time amount until it receives this specific sending signal in the condition without an error can be shortened.
[0020] A receiving means for the OFDM receiving set of this invention to receive the signal with which the interleave processing according to the number of resendings of a sending signal was made by the communications partner, and to perform OFDM processing to said signal, Two or more day interleave means by which day interleave processing which is mutually different to the signal by which OFDM processing was carried out can be performed, A day interleave means to perform day interleave processing corresponding to said interleave processing is chosen from said two or more day interleave processing means. It is characterized by providing a selection means to make the selected interleave means perform day interleave processing to said signal by which OFDM processing was carried out.
[0021] Since day interleave processing according to the interleave processing performed to the input signal among two or more day interleave processings of being mutually different is performed to the above-mentioned input signal according to this invention,

the probability which the same input signal mistakes continuously can be reduced. Thereby, when a certain specific input signal is mistaken, time amount until it receives this specific input signal in the condition without an error can be shortened.
[0022] The OFDM communication device of this invention is characterized by providing the above-mentioned OFDM sending set and the above-mentioned OFDM receiving set.
[0023] Since it has the OFDM sending set which reduces the probability which is mistaken succeeding the time of the same sending signal being received by the communications partner, and the OFDM receiving set which reduces the establishment which the same input signal mistakes continuously according to this invention, the OFDM communication device which can perform good radio can be offered.
[0024] The communication terminal of this invention is characterized by having the above-mentioned OFDM communication device. The base station equipment of this invention is characterized by having the above-mentioned OFDM communication device.
[0025] Since the OFDM communication device which can perform good radio is carried according to this invention, efficient and good radio can be performed.
[0026] Interleave down stream processing to which the OFDM correspondence procedure of this invention performs interleave processing according to the number of resendings of a sending signal to said sending signal among two or more interleave processings, The transmitting process which transmits the sending signal which performs OFDM processing to the sending signal by which interleave processing was made, and by which OFDM processing was made through a transmission line, The receiving process which receives said transmitted signal through said transmission line, and performs OFDM processing to the received signal, It is characterized by providing day interleave down stream processing which performs day interleave processing corresponding to said performed interleave processing to the signal by which OFDM processing was carried out among two or more day interleave processings.
[0027] According to this invention, interleave processing according to the number of resendings of a sending signal is performed to the above-mentioned sending signal among two or more interleave processings of being mutually different. Moreover, since day interleave processing corresponding to the interleave processing performed to the input signal among two or more day interleave processings of being mutually different is performed to the above-mentioned input signal While being able to reduce the probability which the same sending signal mistakes continuously, the probability which the same input signal mistakes continuously can be reduced.
[0028]
[Embodiment of the Invention] Since the subcarrier by which each signal in the sending signal by which OFDM transmitting processing of this invention person was carried out is arranged changes according to the interleave processing made before OFDM transmitting processing, it came to carry out this invention in the receiving side by changing the interleave processing to a sending signal paying attention to the quality of each signal taken out by OFDM reception changing.
[0029] The main point of this invention is having been made to perform interleave processing according to the number of resendings of a sending signal to the sending signal.
[0030] Hereafter, the gestalt of operation of this invention is explained to a detail with reference to a drawing.

[0031] (Gestalt of operation) Drawing 1 is the block diagram showing the configuration of the OFDM communication device concerning the gestalt of operation of this invention. Hereafter, the OFDM communication device concerning the gestalt of this operation is explained taking the case of the case where the 1st communication device and the 2nd communication device equipped with this OFDM communication device both perform radio. In addition, the 1st communication device transmits a signal to the 2nd communication device, and here explains the case where the 1st communication device transmits this mistaken signal again to the 2nd communication device (resending), when an error exists in the signal which the 2nd communication device received.

[0032] First, a sending signal is stored in the resending control section 101 in the transmitting system of the 1st communication device. This sending signal is a signal of for example, a packet unit. The stored sending signal is transmitted to the 1st interleave processing section 102 and the 2nd interleave processing section 103 by the resending control section 101 according to the transmit timing set up beforehand.

[0033] In the 1st interleave processing section 102, interleave processing is made to the signal transmitted by the resending control section 101. That is, the sequence of the signal transmitted by the resending control section 101 is rearranged according to a specific regulation. The signal with which sequence was rearranged by the 1st interleave processing section 102 is outputted to a selector 104.

[0034] In the 2nd interleave processing section 103, interleave processing is made to the signal transmitted by the resending control section 101. That is, the sequence of the signal transmitted by the resending control section 101 is rearranged according to a specific regulation. However, the specific regulation of being used by this 2nd interleave processing section 103 differs from the specific regulation of being used by the 1st interleave processing section 102 mentioned above. The signal with which sequence was rearranged by the 2nd interleave processing section 103 is outputted to a selector 104.

[0035] It is possible to use various interleaves containing a chip interleave, a symbol interleave, etc. as the interleave approach by the 1st interleave processing section 102 and the 2nd interleave processing section 103.

[0036] In a selector 104, the signal after the interleave processing outputted by either the 1st interleave processing section 102 or the 2nd interleave processing section 103 is outputted to the transmitting OFDM section 105 according to control by the resending control section 101.

[0037] It specifically responds to the number of resendings of the packet transmitted by the resending control section 101. Here It responds to whether it is or or the signal by which resending is carried out whose packet transmitted by the resending control section 101 is the signal transmitted for the first time. The control signal of the purport which should output either the signal after the interleave processing from the 1st interleave processing section 102 or the signals after the interleave processing from the 2nd interleave processing section 103 to the transmitting OFDM section 105 It is outputted from the resending control section 101 to a selector 104.

[0038] In addition, in the gestalt of this operation, when it is the signal which the signal after the interleave processing from the 1st interleave processing section 102 is outputted from a selector 104 to the transmitting OFDM section 105, and is resent when the packet transmitted by the resending control section 101 is the signal transmitted for the first time, the signal after the interleave processing from the 2nd interleave processing section

103 shall be outputted.
[0039] Predetermined transmitting OFDM processing is made by the transmitting OFDM section 105, and the signal from a selector 104, i.e., the signal in which interleave processing was carried out by the 1st interleave processing section 102, is arranged at each subcarrier. Processing of a serial and null sequence conversion, primary modulations (QPSK, 16QAM, etc.), IFFT (inverse Fourier transform), etc. is included in this transmitting OFDM processing.
[0040] As a result of carrying out interleave processing in the 1st interleave processing section 102, the signal with which the above-mentioned predetermined transmitting OFDM processing was made here keeps predetermined subcarrier spacing, and it serves as a signal arranged at each subcarrier. That is, respectively like [the 1st - the 4th signal in the signal inputted into the 1st interleave processing section 102] a subcarrier 1, a subcarrier 5, and a subcarrier 9, 4 subcarrier spacing is set and the signal with which the above-mentioned predetermined transmitting OFDM processing was made is arranged.
[0041] The signal with which transmitting OFDM processing was made is transmitted to the 2nd communication device through an antenna 106. The signal transmitted from the 1st communication device is received by the 2nd communication device through a transmission line.
[0042] As for the signal received by the antenna 106, predetermined receiving OFDM processing is made by the receiving OFDM section 107 in the 2nd communication device. Processing of a synchronization, FFT (Fourier transform), transmitting diversity, a synchronous detection (or differentially coherent detection), a parallel serial conversion, etc. is included in this receiving OFDM processing. The signal with which the above-mentioned predetermined receiving OFDM processing was made is outputted to the 1st day interleave processing section 108 and the 2nd day interleave processing section 109.
[0043] In the 1st day interleave processing section 108, the sequence of the signal from the receiving OFDM section 107 is rearranged according to a specific regulation. This specific regulation is equivalent to the specific regulation of having been used by the 1st interleave processing section 102 in the 1st communication device. Thereby, the sequence of the signal from the receiving OFDM section 107 is rearranged so that it may become the same as that of the sequence at the time of this signal being transmitted by the resending control section 101 in the 1st communication device. The signal with which day interleave processing was made by the 1st day interleave processing section 108 is outputted to a selector 110.
[0044] In the 2nd day interleave processing section 109, the sequence of the signal from the receiving OFDM section 107 is rearranged according to a specific regulation. This specific regulation is equivalent to the specific regulation of having been used by the 2nd interleave processing section 103 in the 1st communication device. Thereby, the sequence of the signal from the receiving OFDM section 107 is rearranged so that it may become the same as that of the sequence at the time of this signal being transmitted by the resending control section 101 in the 1st communication device. The signal with which day interleave processing was made by the 2nd day interleave processing section 109 is outputted to a selector 110.
[0045] In a selector 110, the signal after the day interleave processing outputted by either the 1st day interleave processing section 108 or the 2nd day interleave processing section 109 is outputted to the error correction section 111 according to control by the resending

control section 101.
[0046] It specifically responds to the number of reception of the packet received through the antenna 106. Here It responds to whether it is or or the signal by which resending was carried out whose packet received through the antenna 106 is the signal transmitted for the first time by the 1st communication device. The control signal of the purport which should output either the signal after the day interleave processing from the 1st day interleave processing section 108 or the signals after the day interleave processing from the 2nd day interleave processing section 109 to the error correction section 111 It is outputted from the resending control section 101 to a selector 110.
[0047] in addition, when the packet received through an antenna 106 is the signal transmitted for the first time by the 1st communication device in the gestalt of this operation The signal after the day interleave processing from the 1st day interleave processing section 108 is outputted from a selector 110 to the error correction section 111, and when it is the resent signal, the signal after the day interleave processing from the 2nd day interleave processing section 109 shall be outputted.
[0048] Error correction processing is made by the error correction section 111, and the signal from a selector 110, i.e., the signal in which day interleave processing was carried out by the 1st day interleave processing section 108, is outputted to the resending control section 101 as a signal of a packet unit.
[0049] In the resending control section 101, when an error does not exist in the signal of the packet unit by which the error correction was carried out, this signal is outputted as an input signal. Conversely, when an error exists in the signal of the packet unit by which the error correction was carried out, the signal of this packet unit is stored in predetermined memory. Then, after the signal containing the packet of the purport which requires resending of the signal of this packet unit is processed by each part of a transmitting system, it is transmitted to the 1st communication device through an antenna 106.
[0050] Then, in the 1st communication device which received the signal containing the packet of the purport which requires the above-mentioned resending, the signal of the packet unit demanded in resending by the 2nd communication device is transmitted to the 1st interleave processing section 102 and the 2nd interleave processing section 103 by the resending control section 101 according to resending timing. Furthermore, the control signal of the purport which should output the signal after the interleave processing from the 2nd interleave processing section 103 to the transmitting OFDM section 105 from the resending control section 101 to a selector 104 is outputted.
[0051] In a selector 104, the signal after the interleave processing from the 2nd interleave processing section 103 is outputted to the transmitting OFDM section 105 according to the above-mentioned control signal. That is, different interleave processing from the time of being transmitted first is made, and the signal of the packet unit resent is outputted to the transmitting OFDM section 105. Processing which was mentioned above by the transmitting OFDM section 105 is made, and the signal from a selector 104 is transmitted to the 2nd communication device through an antenna 106.
[0052] Here, as a result of carrying out interleave processing in the 2nd interleave processing section 103, the signal after transmitting OFDM processing of the packet resent sets different subcarrier spacing from the time of the first transmission, and it serves as a signal arranged at each subcarrier. That is, respectively like [the 1st - the 4th

signal in the signal inputted into the 2nd interleave processing section 103] a subcarrier 1, a subcarrier 3, a subcarrier 5, and a subcarrier 7, 2 subcarrier spacing is set and the signal after the above-mentioned transmitting OFDM processing is arranged. By this, each signal in the packet resent will be arranged at a different subcarrier from the time of the first transmission.

[0053] In the 2nd communication device, the signal containing the resent packet is received through an antenna 106. The same processing as what the receiving OFDM section 107, the 1st day interleave processing section 108, and the 2nd day interleave processing section 109 boiled the signal received through the antenna 106, respectively, and was mentioned more above is made.

[0054] The control signal of the purport which should output the signal after the day interleave processing from the 2nd day interleave processing section 109 to the error correction section 111 is outputted to a selector 110 from the resending control section 101.

[0055] In a selector 110, the signal after the day interleave processing from the 2nd day interleave processing section 109 is outputted to the error correction section 111 according to the above-mentioned control signal. That is, different day interleave processing from the time of being transmitted first is made, and the signal of the resent packet unit is outputted to the error correction section 111. Error correction processing is made by the error correction section 111, and the signal from a selector 110 is outputted to the resending control section 101.

[0056] Here, by changing the interleave processing to the specific packet set to the 1st communication device in the time of the first transmission and resending explains again in what kind of condition the signal containing this resent packet is received by the 2nd communication device with reference to drawing 3 .

[0057] As shown in drawing 3 , when a certain specific packet is received for the first time by the 2nd communication device, like a subcarrier 1, a subcarrier 5, a subcarrier 9, a subcarrier 13, and --, the signal outputted from the receiving OFDM section 107 sets 4 subcarrier spacing, and it serves as a signal serially taken out from each subcarrier. Since the signal taken out in this way has the bad quality of the signal arranged at a subcarrier 1, a subcarrier 5, a subcarrier 9, a subcarrier 13, and --, it turns into a signal which an error concentrates on a certain specific time amount, so that clearly from drawing 3 .

[0058] On the other hand, when the above-mentioned specific packet is again received by the 2nd communication device, like a subcarrier 1, a subcarrier 3, a subcarrier 5, a subcarrier 7, and --, the signal outputted by the receiving OFDM section 107 sets 2 subcarrier spacing, and it serves as a signal serially taken out from each subcarrier. However, they shall be the condition of the circuit at the time of the above-mentioned specific packet being first received by the 2nd communication device, the condition of the circuit at the time of being received again, and **** identitas.

[0059] Since the signal taken out in this way turns into a signal with which the signal of inferior quality and the quality signal were included by turns, possibility that an error will concentrate on a certain specific time amount serves as a low signal, so that clearly from drawing 3 . That is, in the 1st communication device, since each signal in a specific packet is transmitted after it has been arranged at a mutually different subcarrier, when again transmitted with the case where this specific packet is transmitted first, the quality of each signal in the above-mentioned specific packet received by the 2nd

communication device becomes what is mutually different in each above-mentioned ****. Possibility that an error will concentrate on a certain specific time amount here in the above-mentioned specific packet received by the 2nd communication device since the condition of the circuit in each above-mentioned **** is abbreviation identitas becomes low.

[0060] Therefore, when a circuit condition with the time of transmission of the beginning of a certain specific packet by the 1st communication device and transmission for the second time hardly changes, in the 2nd communication device, possibility that an error will arise becomes very low about the packet resent by the 1st communication device. That is, the situation which a certain specific packet mistakes continuously in the above-mentioned case is avoidable.

[0061] In addition, in the gestalt of this operation, although the case where the interleave processing section and the two day interleave processing sections were prepared, respectively was explained, this invention is not limited to this but can be applied also about the case where the number of the interleave processing section and the day interleave processing sections is increased further. In this case, what is necessary is just to use two or more interleave processing sections and the day interleave processing section which were prepared according to the number of resendings of the packet which transmits. The probability which the same packet mistakes continuously by this can be reduced still more certainly.

[0062] Moreover, although the case where the 1st communication device transmits a signal to the 2nd communication device, and the 1st communication device transmitted this mistaken signal again to the 2nd communication device in the gestalt of this operation when an error exists in the signal which the 2nd communication device received (resending) was explained Since both the 1st communication device and the 2nd communication device have the configuration shown in drawing 1 , this invention The 2nd communication device transmits a signal to the 1st communication device, and when an error exists in the signal which the 1st communication device received, this mistaken signal can be applied also about the case where the 2nd communication device transmits again to the 1st communication device.

[0063] Thus, according to the gestalt of this operation, two or more the interleave processing sections and the day interleave processing sections which perform a mutually different interleave can be prepared, respectively, and the probability which the same packet mistakes continuously can be reduced by using two or more above-mentioned interleave processing sections and the day interleave processing section according to the number of resendings of the packet which transmits, namely, changing the interleave approach. Thereby, when a certain specific packet is mistaken, time amount until it receives this specific packet in the condition without an error can be shortened.

[0064] In addition, in the gestalt of this operation, although the case where interleave processing was changed according to the number of resendings of a certain packet was explained, this invention is not limited to this but can be applied also about the case where the interleave processing section and the day interleave processing section which were prepared are properly used according to various conditions, such as circuit quality. The probability which the packet which received mistakes by this can be reduced.

[0065] Furthermore, the OFDM communication device concerning the gestalt of operation of this invention can be carried in the communication terminal and base station

equipment in digital mobile communication system.
[0066]
[Effect of the Invention] Since it was made to perform interleave processing according to the number of resendings of a sending signal to the sending signal according to this invention as explained above, the OFDM communication device which can reduce the probability which the same packet mistakes continuously can be offered.

[Translation done.]

* NOTICES *

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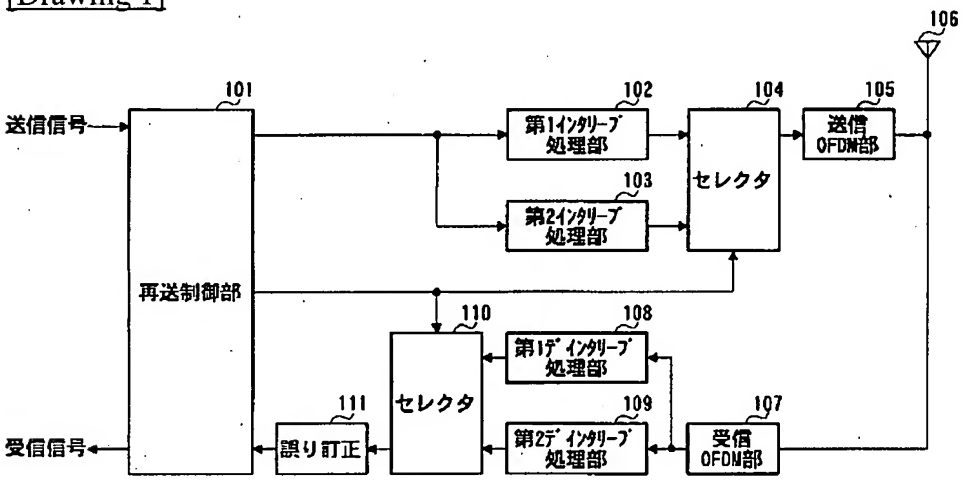
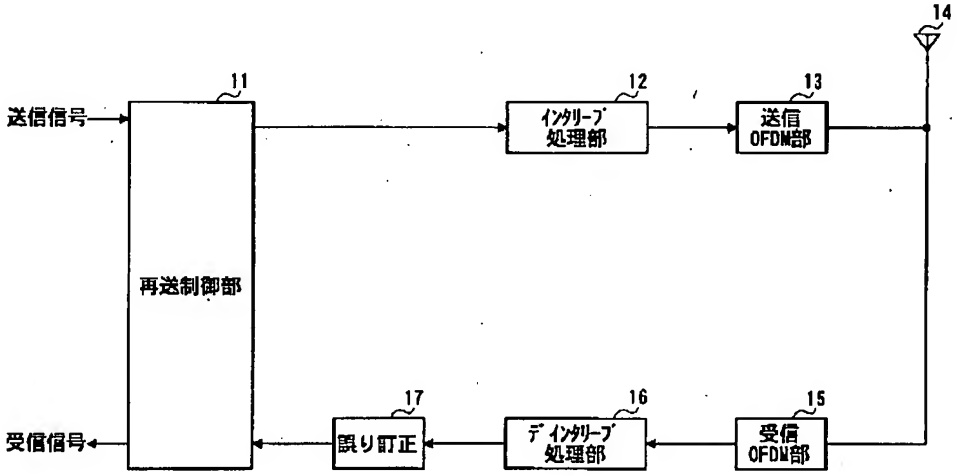
DRAWINGS

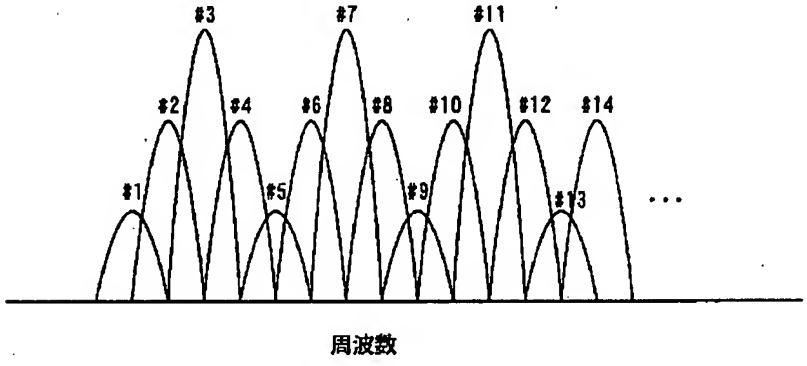
[Drawing 1]



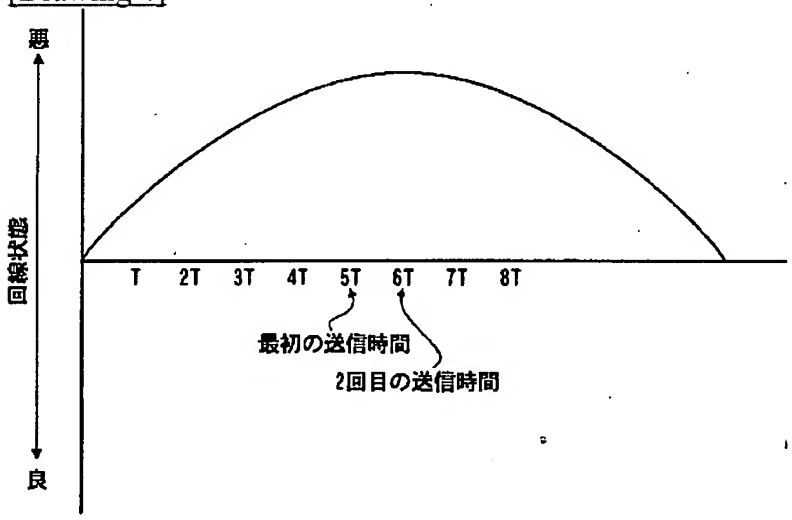
[Drawing 2]



[Drawing 3]



[Drawing 4]



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